Biosensing studies on CuO-MgO nanocomposite for glucose detection

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ABSTRACT

Approximately 3 million people around the world suffer from diabetes. One of the basic indications of an individual suffering from diabetes can be observed in the form of peaked levels of glucose in the blood. Thus, it is imperative for a non-invasive mechanism to be derived through which glucose levels in the blood can be detected throughout a regular time frame. The aim of this project focuses on synthesis of a nanocomposite which can be used to detect glucose levels in the blood in a non-invasive manner. The selected nanocomposite was made from a mixture of CuO and MgO. Once synthesized, it was subjected to a series of tests and scans. The results demonstrated effective and efficient glucose detection activity of the CuO-MgO nanocomposite.

INTRODUCTION

- The current methods for glucose detection are mainly invasive techniques which require obtaining a sample of blood from the patient.
- Nanocomposites can be effectively used for non-invasive detection of glucose in the blood for early detection and constant monitoring in any individual suffering from diabetes.

METHODOLOGY

0.5 M $Cu(NO_3)_2$ + DD H_2O 0.5 M $Mg(NO_3)_2$ + DD H_2O

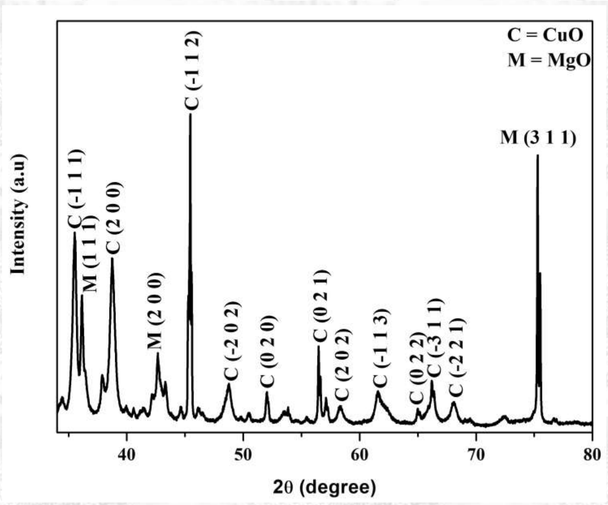
Mix both solutions together under constant stirring for 2 hrs

The resulting solution was centrifuged at 3000rpm

Calcinated at 500 °C for 4 hrs

RESULTS & DISCUSSION

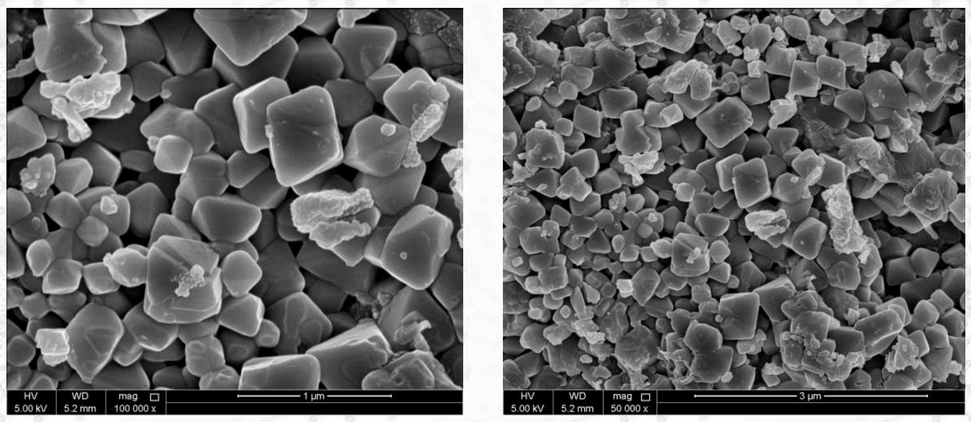
Structural Studies



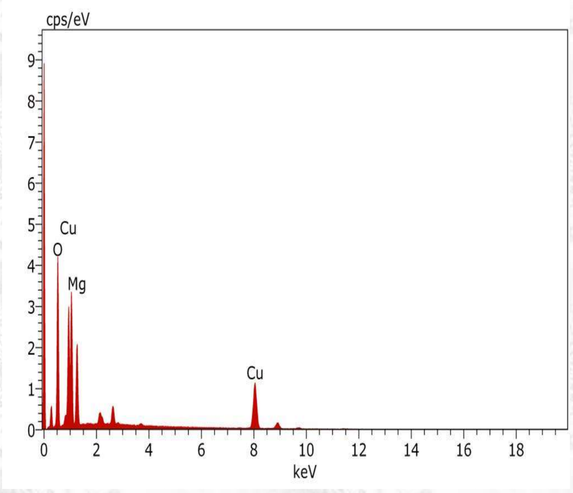
X-Ray Diffraction Results of the synthesized nanocomposite

Sample	Phase	Lattice parameter (nm)	Crystallite size (nm)	Dislocation density (δ) x 10^{14} (lines/m^2)
CuO-MgO	CuO (Monoclinic)	a=0.4681 b= 0.3424 c= 0.5128	35.01	8.17
	MgO (cubic)	a=b=c=0.4210	33.98	8.64

Lattice parameters obtained from CuO-MgO nanocomposite



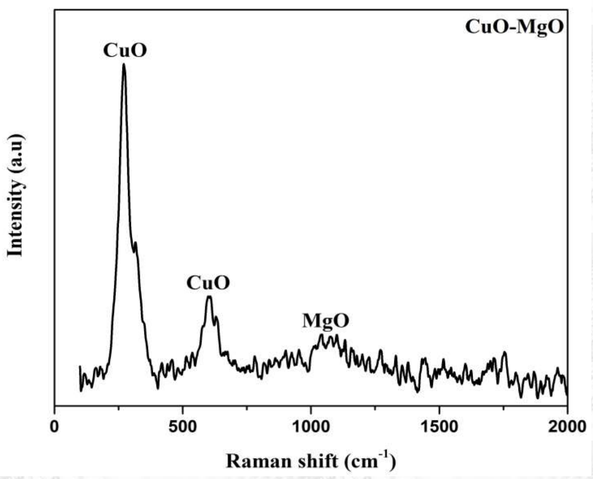
SEM – CuO-MgO nanocomposite - Kidney stone monoclinic crystals



EDAX results showing only the presence of Cu, Mg and O in the nanocomposites thus proving the purity of the nanocomposites

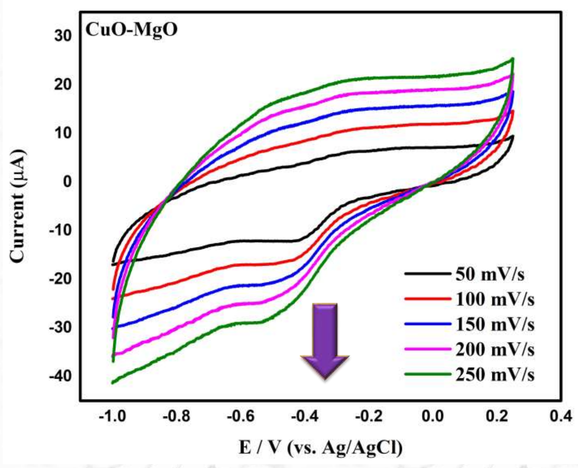
Element	Wt (%)	At (%)
Cu	22.27	74.42
Mg	21.07	18.21
O	56.66	7.37

Raman Studies

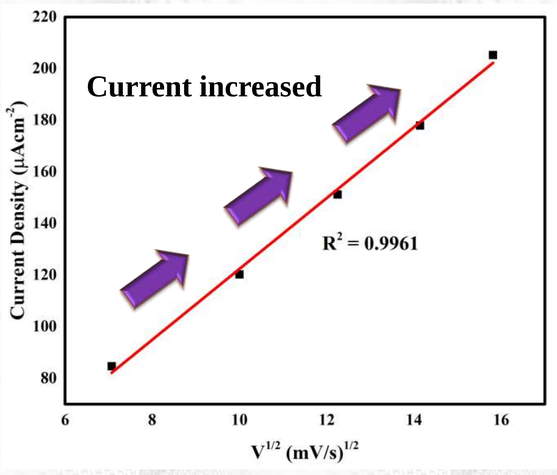


Raman shift showing the presence of CuO and MgO at the corresponding intensity values

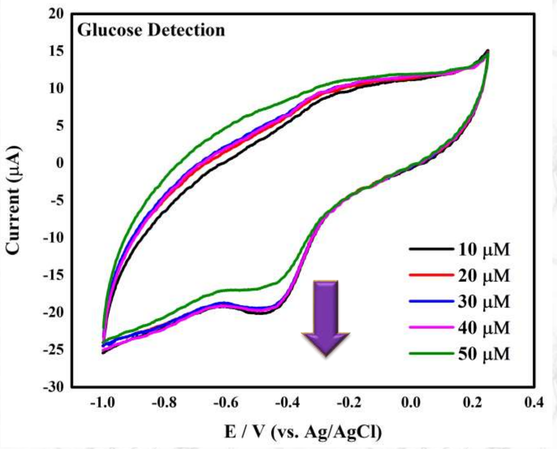
Tests for Biosensing Properties



CV with different scan rates



Current density measured at different scan rates



Scan for glucose detection

BENEFITS TO QATAR

Given the increasing population with health issues, in particular diabetes, a non-invasive method to detect the levels of glucose in blood is imperative. Using such a nanocomposite is the first step towards achieving this method of effective and efficient detection of glucose levels in the blood so that any abnormal patterns or fluctuations may be detected as well as for the purposes of early detection of diabetes. Furthermore, it can also be used to detect/monitor if an individual with a previous family history of diabetes has high levels of glucose in their blood so that they can prevent diabetes or at the very least, delay it.

CONCLUSION

XRD: CuO (monoclinic), MgO (cubic) structure
SEM with EDAX: Kidney stone monoclinic crystals
Raman: 270 (CuO), 600 (CuO), 1071 cm^{-1} (MgO)
Biosensors: The modified electrode shows a sensitivity 0.48 µA cm^{-2} $µM^{-1}$
Glucose sensor development is important for diabetic Patients.

REFERENCES

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